PRIORITY DOCUMENT

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I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2003903687 for a patent by NOTE PRINTING AUSTRALIA LIMITED as filed on 16 July 2003.

WITNESS my hand this
Twenty-second day of October 2003

J. Billingsley

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SUPPORT AND SALES

AUSTRALIA

Patents Act 1990

PROVISIONAL SPECIFICATION

Invention Title: **Embossed optically variable devices**

The invention is described in the following statement:

EMBOSSED OPTICALLY VARIABLE DEVICES

Field of the Invention

The present invention relates to a method of forming a security device and a security device formed thereby. In particular, although not exclusively, the invention relates to security devices which may be provided on security documents or tokens such as banknotes, cheques, travellers cheques, credit cards, identification cards, passports, stock and share certificates, tickets and the like, and is particularly concerned with providing a security device for security documents which is readily discernible only at certain viewing angles and which is difficult to copy or counterfeit.

Background to the Invention

The use of transitory embossed images as security devices in security documents has been previously proposed. For example, US 5,199,744 discloses a security device formed by embossing a substrate with a transitory image in association with an embossed non-transitory linear area which is visible from substantially all viewing angles. The transitory image may be a transient image which is one that can be seen when viewing the substrate normally but not when the substrate is viewed off normal, or a latent image which is one that cannot be seen when viewing the substrate normally but which can be seen when the substrate is viewed from certain off normal angles. In US 5,199,744, the surface to be embossed should be specularly reflecting, such as provided by a metallic ink. Also, the security device of US 5,199,744 requires the embossed non-transitory linear area to circumscribe or define an identifiable portion of the design element.

Although US 5,199,744 provides a transitory embossed security device which has some unusual visual effects, it has been discovered that more striking visual effects can be achieved by embossing where the metallic ink is covered by a transparent or translucent layer.

Summary of the Invention

In accordance with a first aspect of the present invention, there is provided a method of forming a security device including: providing a sheet including a substantially transparent or translucent layer and a reflective layer, at least part of which is visible through at least a portion of the transparent or translucent layer on a first side of the sheet at certain viewing angles; and blind embossing the sheet from the first side of the sheet at least within said portion.

The embossing produces a transitory embossed image which is visible at viewing angles within a window of high reflection. When the device is viewed within this window, the reflective layer produces relatively coherent reflections. The surface of the substantially transparent or translucent layer also produces relatively coherent reflections, except where the surface is interrupted by the pattern of the embossed image. The embossed image will cause some scattering of the light reflectance and transmittance. To some extent, depending on the embossing process, the surface of the reflective layer may also be interrupted by the embossments. This slightly specular scattering of the light is of high contrast to the relatively coherent reflection from the remainder of the surface of substantially transparent or translucent layer. This causes the embossed image to be visible. The image is particularly enhanced due to the gloss characteristics of the transparent layer, producing a higher degree of reflectivity than embossment in a reflective layer alone. A characteristic feature of the invention is that during rotation to oblique viewing angles, the embossed image becomes less apparent or substantially invisible. This is because outside the window of high reflection, the reflective layer will have a dull appearance as will the surface of the substantially transparent or translucent layer. The reflection from the embossed image produces only slight specular scattering of the light. The appearance of the embossed image will therefore not be in contrast to the reflective layer and thus the embossed image is less apparent or effectively invisible. The embossed image is also substantially invisible when viewed in transmission i.e. when held up to light.

The security device is defined above as being formed in a sheet which may

be a thin piece of material of any shape whether flexible or rigid i.e. card-like. The sheet need not be broad or expansive but could constitute a small disk about the size of a coin which may be applied to a larger document or article. A plurality of such security devices may be produced on a large sheet from which each of the security devices are separated for application to a security document or article. For this purpose, the sheet bearing the security device may be provided with an adhesive backing. In an alternative preferred form of the invention, the sheet may constitute the security document or security article itself such as a bank note with sufficient strength characteristics for wear and tear as a stand alone security document.

In a more preferred form of the invention, there is provided a method of forming a security device including: providing a sheet including a substantially transparent or translucent layer and a reflective layer, at least part of which is visible through at least a portion of the transparent or translucent layer on a first side of the sheet at certain viewing angles, the portion of the transparent or translucent layer being defined by an opacified portion of the sheet forming a window in the sheet; and blind embossing the sheet from the first side of the sheet at least within the window.

In accordance with another preferred form of the invention, there is provided a method of forming a security device including: providing a sheet including a substantially transparent or translucent layer and a reflective layer, at least part of which is visible through at least a portion of the transparent or translucent layer on a first side of the sheet at certain viewing angles; blind embossing the sheet from the first side of the sheet at least within said portion; and opacifying the sheet to define said portion of the transparent or translucent layer as a window in the sheet.

Thus, from the foregoing preferred forms of the invention, it can be seen that opacification of the first side of the sheet can occur before or after the step of embossing. "Opacification" need not necessarily imply 100% opacity but can be used to mean an increase in the opaqueness which reduces light transmission.

Where the window is already formed in the sheet before the embossing, the sheet may include opaque paper or plastic with a clear window formed therein. In the case of paper, in order to obtain the appropriate surface smoothness which is required to achieve high reflectivity of the reflective layer, the paper may be calendered through the intaglio process.

In a more preferred form of the invention, the sheet may include a transparent substrate with one or more opacifying layers applied to the first side to create a window. An appropriate substrate is a laminated film of biaxially oriented polymeric material, such as disclosed in Australian patent no 558476 (or US 4,536,016). Rather than applying the opacifying layers to the substrate, means may be provided to selectively opacify regions within the substrate. A polymer substrate is preferred because of the smoother surface in comparison to paper.

Alternatively, transparent card materials such as polycarbonate or polyvinylchloride (PVC) may be used. The reflective layer may be applied to one side or embedded into the card material.

Opacification may also occur to the second side of the sheet particularly in the case where a transparent substrate is used. The opacification may occur to create a window in register with the window formed on the first side of the sheet. Alternatively, the opacification on the second side may form a complete covering so as to form a half window as described in Australian patent no 726,523 (or US 6,471,247). The opacification may take place after the step of blind embossing. Opacification on the second side results in the reflective layer being embedded between the opacification layer and the transparent layer, protecting the reflective layer against chemical and physical attack.

In an alternative form of the invention, the substantially transparent or translucent layer may be formed by means of a coating applied to a substrate. The substrate may constitute the reflective layer, for example a layer of foil. Alternatively, the coating may be applied to a separate substrate layer, in which case the coating is applied over the reflective layer to sandwich the reflective layer between the coating and the substrate.

A suitable coating may comprise UV curable gloss overcoat varnish which could be printed using offset or gravure printing. Preferably such coatings should have a relatively high reflectance of at least 70 gloss units and have a suitable adhesion to the reflective layer. Opacifying inks may be applied over the coating to create a window on the first side of the sheet.

A substrate *per se* is not necessarily essential to the present invention. The bonded transparent layer and reflective layer may together be of sufficient strength to undergo the embossing process. For example, the sheet may simply comprise a transparent layer in the form of a film of transparent material bonded to a layer of foil. Alternatively, the metal reflective layer may be sputtered onto the transparent layer.

Irrespective of the medium used to create the substantially transparent or translucent layer, preferably it is has a glossy surface, the reflection from which enhances the effect created by the embossing in the reflective surface of the reflective layer. The transparent layer should have a gloss value of 75, but preferably 80-90. These values are measured using a Gardener micro-tri-gloss meter at an angle of 45°.

An additional benefit of the substantially transparent or translucent layer is that it provides a protective coating over the reflective layer against chemical or physical attack.

The reflective layer is preferably also highly reflective. The reflective layer should have a gloss value of at least 60 units, as measured with a Gardener micro-tri-gloss meter at an angle of 45° As mentioned above, the reflective layer may be comprised of a reflective material such as metal foil applied to a substrate.

Alternatively, the reflective layer may be formed by printing with reflective ink. A preferred printing method is the gravure printing process which can achieve a layer of ink of two-three microns in thickness (dry weight). Where the security device is formed on a larger document such as bank note, the printing of the reflective layer by the gravure process may be conducted when other parts of the

security document are being printed. The reflective layer can also be printed with the silk screen process.

The reflective layer may comprise metallic material applied to a substrate such as by sputtering or a vapour deposition process. Alternatively, the substrate itself could be made of a suitable material such as a foil.

The extent of the reflective layer is preferably sufficient to contain the whole of the embossed image. Where the security device is incorporated into a security document or article, the reflective layer may constitute a patch or a specific region on the document or article. The reflective layer is preferably continuous within the patch or region.

The reflective inks may comprise metallic ink such as silver, gold or irodine.

The reflective ink may be of the type comprising optically variable pigment. The term optically variable pigment as used herein refers to a coating composition, such as an ink, which provides a colour shift between two distinct colours with the colour shift being dependent upon the viewing angle. An example of such an optically variable ink (OVI) is described in EP 0,984,043 of SICPA Holding SA, and OVI is a Registered Trade Mark of SICPA Holding SA.

One example of an optically variable pigment is a green/blue OVI which appears green when viewed in reflection at viewing angles around the normal to the substrate, and which appears blue when viewed at acute angles to the plane of the substrate. Another example of an optically variable coating is one which changes colour from gold when viewed at normal incidence, to green when viewed obliquely.

Combinations of various reflective inks may be used to make up the reflective layer. For example, a secondary image may be created within the reflective layer using two different types of reflective inks.

The blind embossing may be conducted by a stamping operation.

Preferably, the blind embossing may be conducted by the process of intaglio printing, except without ink. This enables a deeper emboss to be achieved than can be achieved with ink. Where the security device is incorporated into a larger document or article such as a bank note, the blind embossing operation may use the same intaglio printing plate to emboss the security device as is used to print other portions of the document or article, except that the blind embossing is carried out by un-inked portions of the plate. The printing and embossing could occur in line on a continuous web based process as used in the bank note production and labels industry.

The embossed image may comprise a set of lines or dots.

It has also been discovered that unusual visual effects can be obtained when the transitory embossed image includes a first set of embossed lines or dots extending in one direction, and a second set of embossed lines or dots extending in a different direction. The first set of embossed lines or dots may form a first part or a background of the transitory embossed image and the second set of embossed lines or dots may form a second part of the transitory embossed image, eg indicia, such as numbers and/or lettering, or a picture. In one preferred embodiment, the second set of embossed lines or dots extends substantially perpendicularly to the first set of embossed lines or dots.

Alternatively, the pattern of the embossing may include indicia such as letters or numbers. Alternatively, the embossing pattern may comprise a device such as a logo or a crest. In such a pattern, the embossed image may be formed against a plain non-embossed background.

In accordance with another aspect of the present invention there is provided a security device including: a reflective layer; a substantially transparent or translucent layer; a blind embossed image formed through the substantially transparent or translucent layer, at least part of which is visible through the transparent or translucent layer at viewing angles within a window of high reflection, wherein the substantially transparent or translucent layer forms a continuous covering over at least said part of the embossed image.

In accordance with yet another aspect of the present invention, there is provided a method of forming a security device including providing a substantially transparent or translucent layer, blind embossing from a first side of the substantially transparent or translucent layer to produce an embossment in the layer;

applying a reflective layer to the other side of said substantially transparent or translucent layer at least in part register with the embossment.

Thus, the embossment may be created in the transparent layer, prior to the addition of the reflective layer while still achieving the unusual visual effects of the present invention. Other desirable features set out above may be incorporated in the invention set out above.

Brief Description of the Drawings

The present invention will now be described in more detail, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a schematic plan view of a security document incorporating a transitory embossed image;

Figure 2 is an enlarged view of the optically variable transitory embossed image of Figure 1;

Figure 3 is a schematic view of the security document of Figure 1 being viewed in reflection from a first viewing angle;

Figure 4 is a schematic view of the security document being viewed in reflection from a more oblique viewing angle;

Figure 5 is a schematic view of the security document being viewed in reflection from another oblique viewing angle;

Figure 6 is a schematic section through the security document on the line

X-X of Figure 1 being viewed at a first viewing angle;

Figure 7 is a schematic view similar to figure 6 except being viewed from a more oblique viewing angle;

Figure 8 is a schematic section through a security document during the blind embossing step;

Figure 9 is a plan view of a security device bearing a simple image;

Figure 10 is a schematic view of a security document incorporating the device of Figure 9 when viewed in reflection at a first viewing angle;

Figure 11 is a schematic view of the security document of Figure 10 when viewed in reflection at a second oblique viewing angle; and

Figure 12 is a plan view of another alternative security device.

Figures 1 to 5 show a rectangular security document 1, such as banknote, which is provided with a security device 3 in the form of a transitory embossed image. The remaining region 4 of the security document is substantially opaque. The opaque region 4 is printed with indicia.

As shown in Figure 6, the security document 1 of Figure 1 is preferably formed from a substrate 10 of transparent plastics material with opacifying layers 14 on both sides of the substrate 10 except in a portion 12 on the first side of the substrate 10. The portion 12 forms the transparent window 2 in the security document. Preferably, the transparent plastics material forming the substrate 10 is a laminated film of biaxially oriented polymeric material, such as disclosed in Australian patent no. 558476 (AU-87665/82). It will, however, be appreciated that the security document 1 may be formed from other materials, eg a substantially opaque paper or plastics substrate with a piece of transparent plastics material inserted into the substrate to form the transparent window 2.

The opacifying layers 14 preferably comprise a coating of a substantially

opaque ink applied to opposite surfaces of the substrate 10, although it will be appreciated that other opacifying layers may be used. For example, a transparent plastics substrate may be sandwiched between layers of substantially opaque paper or plastics material.

Referring more particularly to Figures 2 and 6, the security device 3 comprises a reflective layer 11 of metallic or optically variable pigment applied to an area 13 of the substrate 10 which is embossed with sets of embossed lines 15, 16 extending in different directions to form a transitory embossed image. As shown in Figure 2, the area 13 is elliptical in shape. The first set of embossed lines 15 extend transversely across the longitudinal axis of the elliptical area 13, and the second set of embossed lines 16 extend parallel to the longitudinal axis of the elliptical area 13. The first set of embossed lines 15 form a first part, the background, and the second set of embossed lines 16 form a second part, the letters OVI, of the transitory variable embossed image.

The reflective layer 11 may be comprised of metallic ink 11. Two suitable systems (silver and gold) are described below.

The formulations and gravure engraving specifications are as follows:

Silver coloured reflective patch,

Eckart Aluminium (PCA)-18% Syloid 308-0.5-1.0%

Resin (two pack polyurethane system)-35% Catalyst-5.3%

MIBK-3%

Add Ethyl Acetate to achieve a printing viscosity of 21-23 secs. using Zahn cup No. 2.

Gold coloured reflective patch,

Eckart Gold (Rotoflex, Resist Grade Rich Pale Gold)-31%

Resin (two pack polyurethane system)-29% MIBK-3%

Syloid 308-0.5-1.0% Catalyst-4.4%

Add Ethyl Acetate to achieve a printing viscosity of 21-23 secs. using Zahn cup No. 2

The cylinder configuration used for these pigments is:

Wall = 10 µm Width = 200.1838 µm

Channel = 36 µm Cell Depth = 57.78807 µm

Lines/cm = 59 µm Stylus = 120°

Screen = 41.2 µm

Alternatively, an optically variable pigment may be used in the present invention instead of metallic ink. A preferred type provides a colour shift between two distinct colours with the colour shift being dependent upon viewing angle. Such optically variable inks may be made by producing an optically variable thin film structure using layers of metallic or high refractive materials (eg certain metal oxides or metal sulphides) and dielectric materials, grinding the film into microflakes and adding the flakes to an appropriate ink medium. Another method for the production of an optically variable pigment which incorporates a totally reflecting layer made by physical vapour deposition from aluminium alloy is disclosed in EP0984043 of SICPA Holding SA.

As shown in Figure 6, a transitory embossed image 3 is formed within the window 2 of the security document 1. While Figures 6 and 7 illustrate a section through x-x of Figure 1, Figure 6 and 7 may also be representative of a section through the security document illustrated in Figure 9 in which a simple image 30 is embossed into the security document against a plain un-embossed background 32. When the document is viewed within a window of high reflection (Figure 10), the reflective metallic ink produces relatively coherent reflections. Similarly, the

external surface of the transparent substrate 10 will also produce relatively coherent reflections, except where the surface is interrupted by the pattern of the embossed image. The embossed image 30 will cause some scattering of the light reflectance and transmittance. To some extent, depending upon the embossing process, the surface of the metallic ink will also be interrupted by the embossments causing some scattering of the reflected light. This slightly specular scattering of the light is of high contrast to the relatively coherent reflections from the remainder of the surface of the transparent substrate 10 and the reflective metallic ink 11. This contrast causes the embossed image 30 to be visible.

When the document is viewed outside the window of high reflection at an oblique angle as shown in Figure 7 and Figure 11, the reflective metallic ink will have a dull appearance. Likewise the non-embossed part of the surface of the transparent substrate 10 will not have a glossy appearance. The reflection from the embossed image produces only slight specular scattering of the light and thus will not be visible at oblique viewing angles. Therefore, the appearance of the embossed image will not be in contrast to the relatively dull appearance of the reflective metallic ink 11 and as a result, the embossed image will be essentially invisible.

The transitory effects exhibited by the embossed image forming the security device 3 of Figures 1 and 2 will now be described with reference to Figures 3 to 5.

Figures 3 and 4 show the security device 3 being viewed in reflection at different angles through a rotation in a plane substantially perpendicular to the substrate and to the direction of the longitudinal lines of the second set of embossed lines 16. When the security device is viewed at angles within a window of high reflection around the perpendicular to the plane of the substrate as shown in Figure 3, the reflected light from the first set of embossed lines 15 appears bright due to a high degree of reflection from the parallel lines. The light is reflected from the peaks of the embossed structure. The second set of embossed lines 16 reflect light to a lesser degree and appear darker or duller. Thus, the transitory image is visible at those viewing angles due to a contrasting colour level of brightness. As the viewing angle increases from the perpendicular to an oblique

viewing angle as shown in Figure 4, the part of the image formed by the first set of embossed lines 15 extending parallel to the direction of rotation changes to being dull, because this angle is outside the window of high reflection and due to the orientation of the lines towards the viewer, reflected light is not visible at this angle. The part of the image formed by the second set of embossed lines 16 extending perpendicularly to the viewing direction changes to being brighter because of visible scattering due to the perpendicular orientation of the lines and thus creates a more striking appearance. Thus, the transitory image (the letters OVI) formed by the second set of embossed lines 16 becomes highly visible at this oblique viewing angle owing to the contrast between the letters OVI formed by the second set of lines 16 and the duller background formed by the first set of embossed lines 15.

At certain angles between that within the window of high reflection of Figure 3 and that of Figure 4, both sets of lines 15, 16 reflect light in an equal measure and thus the transitory embossed image will be essentially invisible.

Figure 5 shows the security device being viewed in reflected light at an oblique viewing angle in a direction substantially parallel to the second set of lines 16 and perpendicular to the first set of lines 15. From this viewing angle, the part of the image formed by the first set of embossed lines 15, which are now perpendicular to the viewing direction, has changed to being bright due to the viewer being at an optimum angle for viewing scattering of the perpendicular lines 15. The part of the image formed by the second set of embossed lines 16, which are now parallel to the viewing direction, has changed to being comparatively dull since the angle is outside the window of high reflection and additionally, the viewer sees little scattering at the angle. Once again, the transitory image (the letters OVI) formed by the second set of embossed lines 16 is visible at this viewing angle owing to the contrast between the different sets of embossed lines 15 and 16.

When the oblique viewing angle changes from the oblique angle of Figure 4 to the oblique angle of Figure 5, ie in a horizontal plane substantially parallel to the plane of the substrate, the transitory image disappears because at intermediate

viewing angles both parts of the image formed by the first and second sets of embossed lines appear the same colour/brightness at that angle.

Thus, the changing patterns of bright and dull as the security document is moved through different angles create a visual effect which cannot be reproduced by normal photocopying machines. Thus, the visual effect serves as a useful security feature easily distinguishable/recognisable by the general public. Enhanced visual effects can be achieved through the use of optically variable pigment as described in our copending application 2002951870.

In a preferred method of manufacturing a security document or a security device such as described with reference to Figures 1 to 7, the layer of reflective ink 11 is applied to one side of the substrate 10 in the area where the security device 3 is to be located in a printing operation eg by silk screen printing, offset or gravure printing. Then, the opacifying layers 14 are applied to opposite surfaces of the transparent substrate 10 eg by printing over region 4 of the substrate. This step could also be done after the step of creating the embossment. The area of the substrate 10 containing the layer of optically variable pigment 11 is embossed, engraved or otherwise deformed to form the transitory embossed image. As shown in Figure 8 the embossing step is performed by applying pressure to at least one side of the substrate in an intaglio printing operation in which raised printed lines are applied to at least one side of the substrate 10 in the opaque region 4. The embossing step is performed on the opposite side of the substrate 10 to the side on which the layer of optically variable ink 11 is applied. This has the benefit of reducing the likelihood of the ink layer 11 cracking. As shown, the embossing is performed by passing the substrate through the nip of an intaglio press having a plate cylinder 20 and an impression cylinder 24 for applying pressure. The engraving 20 on the plate cylinder 22 faces the side of the transparent substrate opposite to that to which the reflective layer 11 is applied.

In the embodiment described in connection with Figures 1 to 5, the transitory image may comprise of embossed lines formed in the substrate, the lines having a predetermined height H and a predetermined spacing S. The height H may vary from a minimum of about 5 microns to a maximum

corresponding to the maximum embossable height of the substrate. The spacing S depends on the height and the ratio S:H is typically from about 6:1 to 2:1.

Figure 12 is a plan view of an alternative security device 40. The reflective layer of the device 40 is made up of two colours with a silver moon 42 and a gold background 44. The embossed background (not shown) may relate to the shape of the silver moon 42 or alternatively be an independent image.

It will be apparent from the description above that the present invention provides a security device which has some unusual visual effects. A security document incorporating such a security device is also difficult for counterfeiters to reproduce. It would not be possible to produce the effects of the transitory embossed image by colour photocopying, and a counterfeiter would require access not only to an appropriate transparent polymeric substrate, but also the specific reflective ink used by the document printing authority and appropriate embossing apparatus in order to produce a counterfeit document.

It will also be appreciated that various modifications and alterations may be made to the embodiments described above without departing from the scope and spirit of the present invention. For example, the transitory embossed image may be formed by at least one set of embossed dots, which extend in lines substantially parallel to other lines of dots in the set. Also, the area of reflective ink may extend outside the area which is embossed with the lines or dots. Preferably, however, the embossed image is formed by at least two sets of embossed lines or dots extending at different angles to one another. It will also be appreciated that more than two sets of embossed lines or dots may be provided to form a more complex transitory embossed image with different parts of the image appearing at different oblique angles.

NOTE PRINTING AUSTRALIA LTD

By their Registered Patent Attorneys
Freehills Carter Smith Beadle

16 July 2003

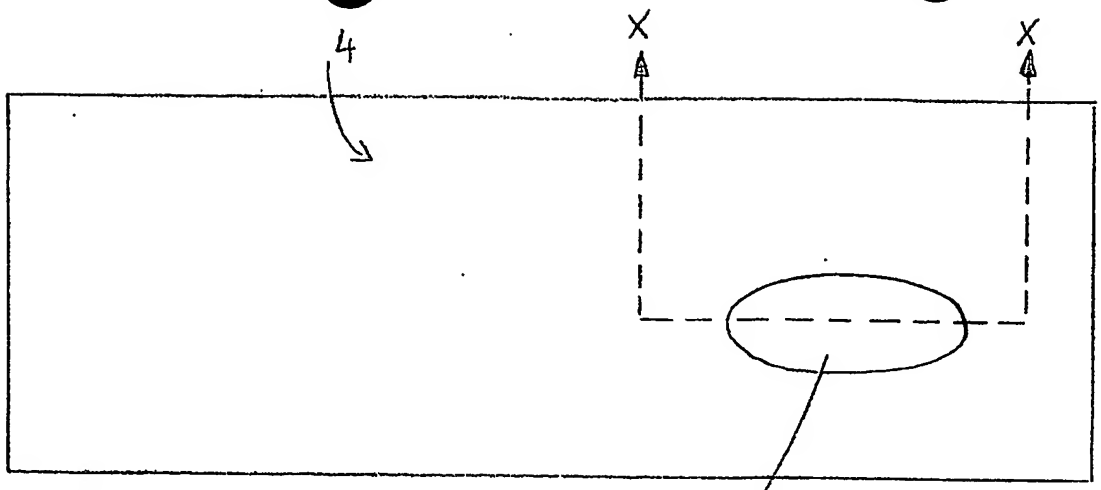
4
X
X
3
1

FIG.1

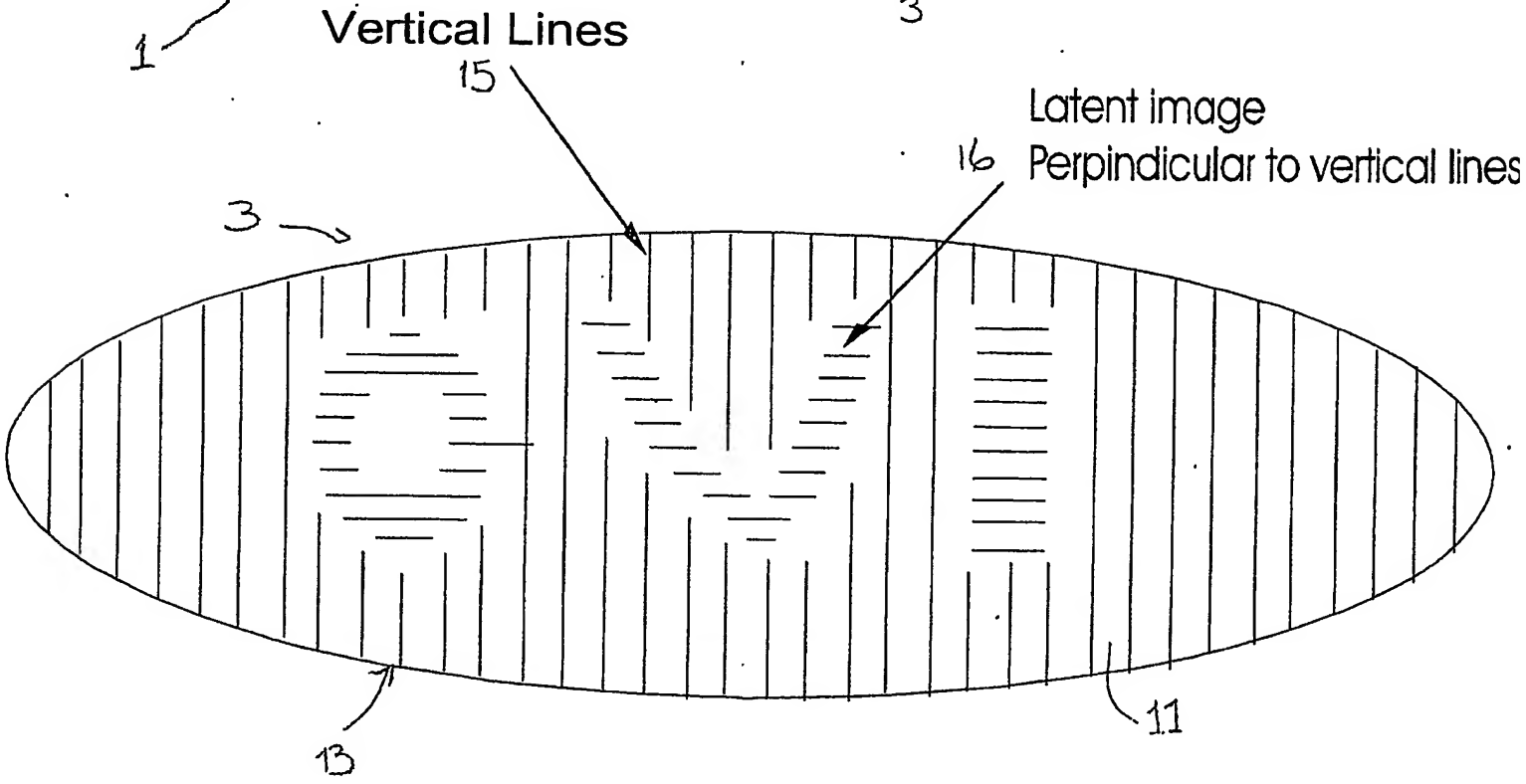
Vertical Lines
15
Latent image
16
Perpindicular to vertical lines
3
13
11

FIG. 2

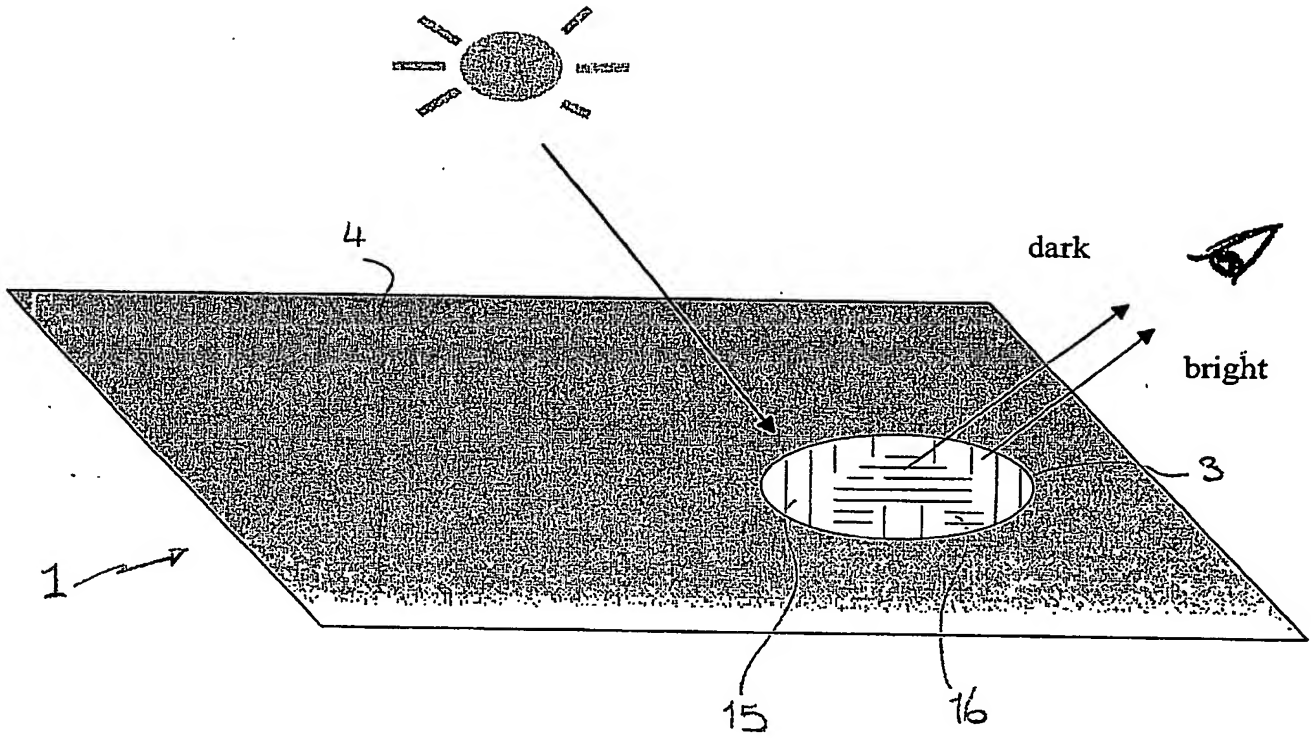

FIG. 3

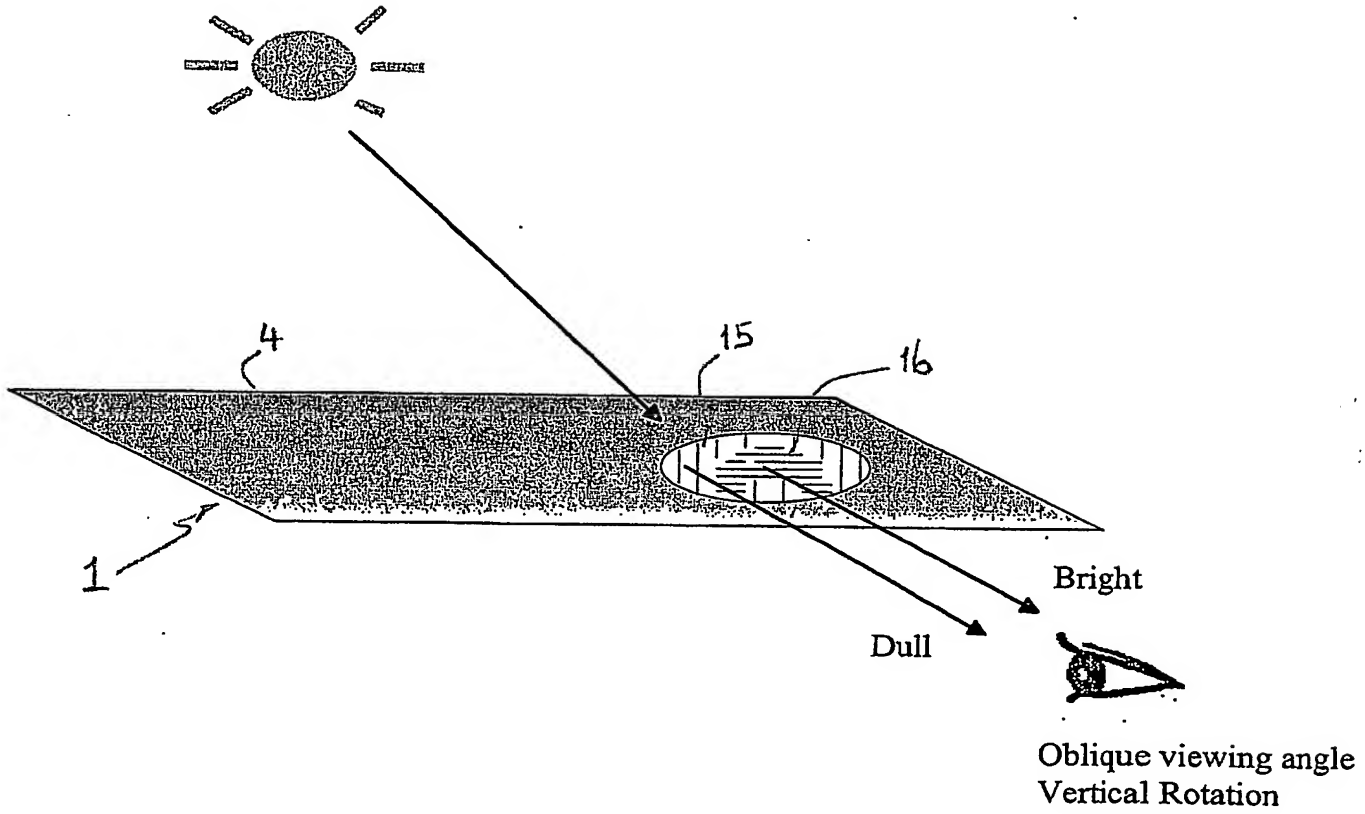
4
15
16
1
Bright
Dull
Oblique viewing angle
Vertical Rotation

FIG. 4

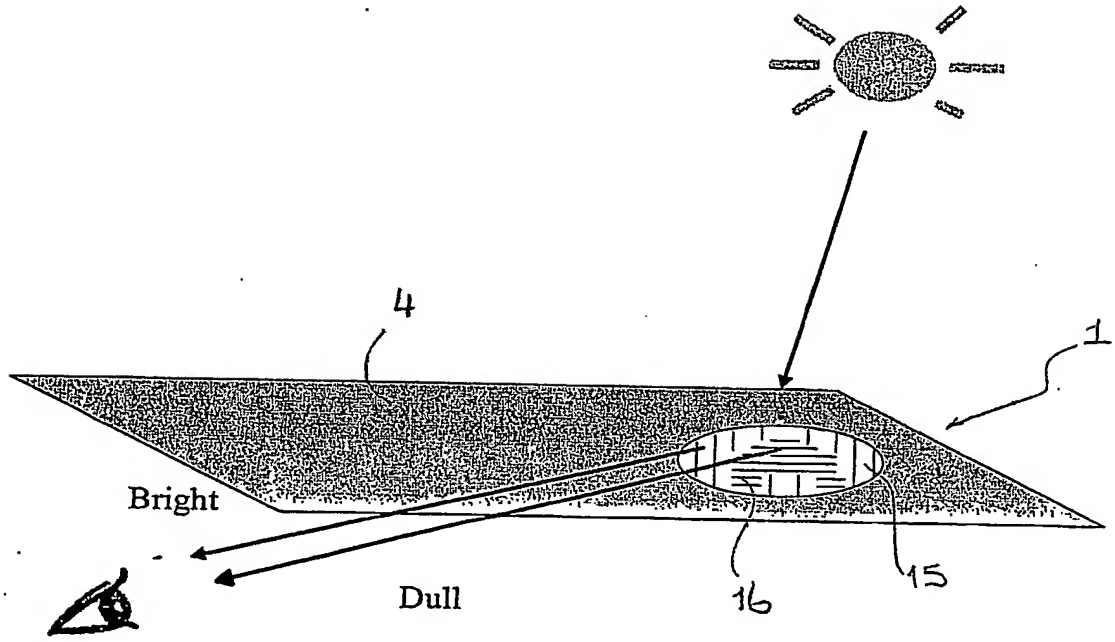
4
1
Bright
Dull
16
15
Oblique viewing angle
Horizontal Rotation

FIG. 5

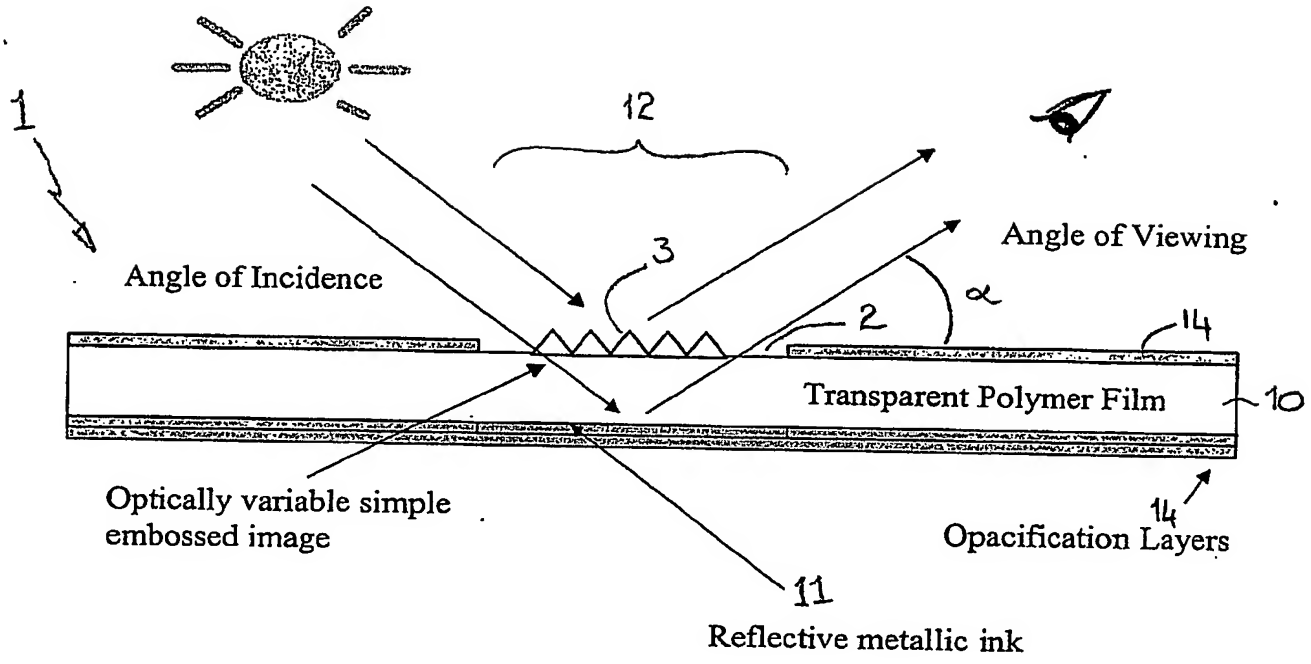
1
12
Angle of Incidence
3
Angle of Viewing
α
2
14
Transparent Polymer Film
10
Optically variable simple
embossed image
14
Opacification Layers
11
Reflective metallic ink

FIG. 6

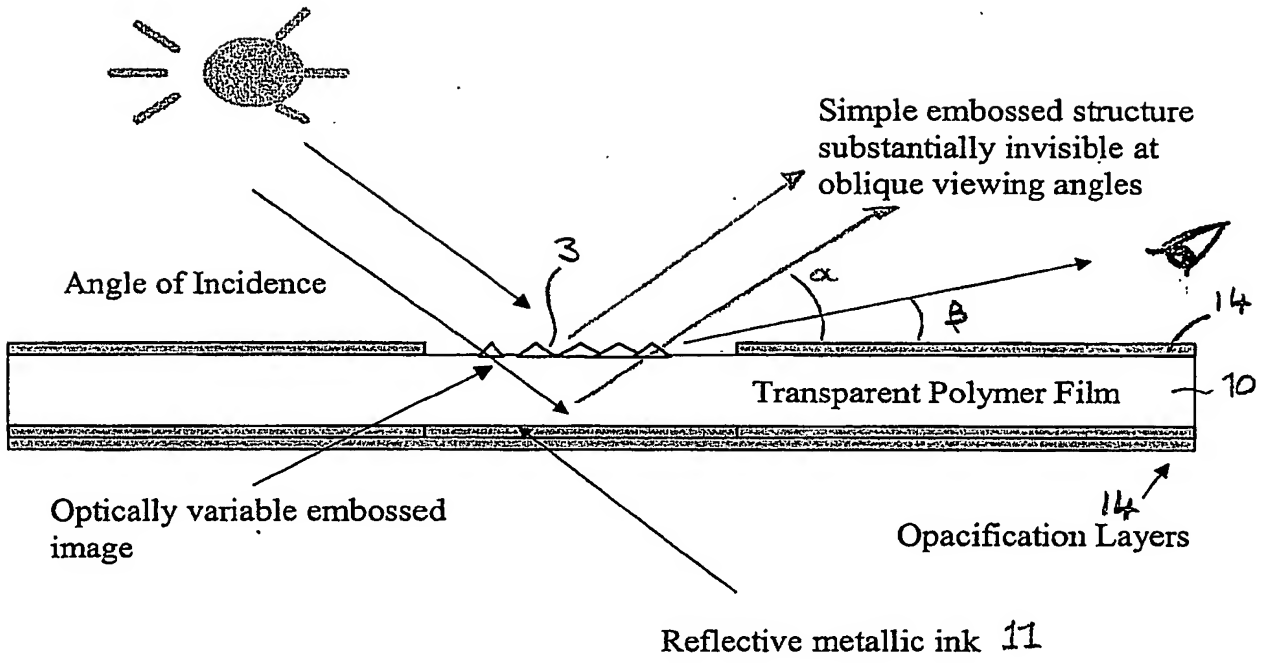
Simple embossed structure substantially invisible at oblique viewing angles
Angle of Incidence
3
α
β
14
Transparent Polymer Film
10
Optically variable embossed image
14
Opacification Layers
Reflective metallic ink 11

FIG. 7

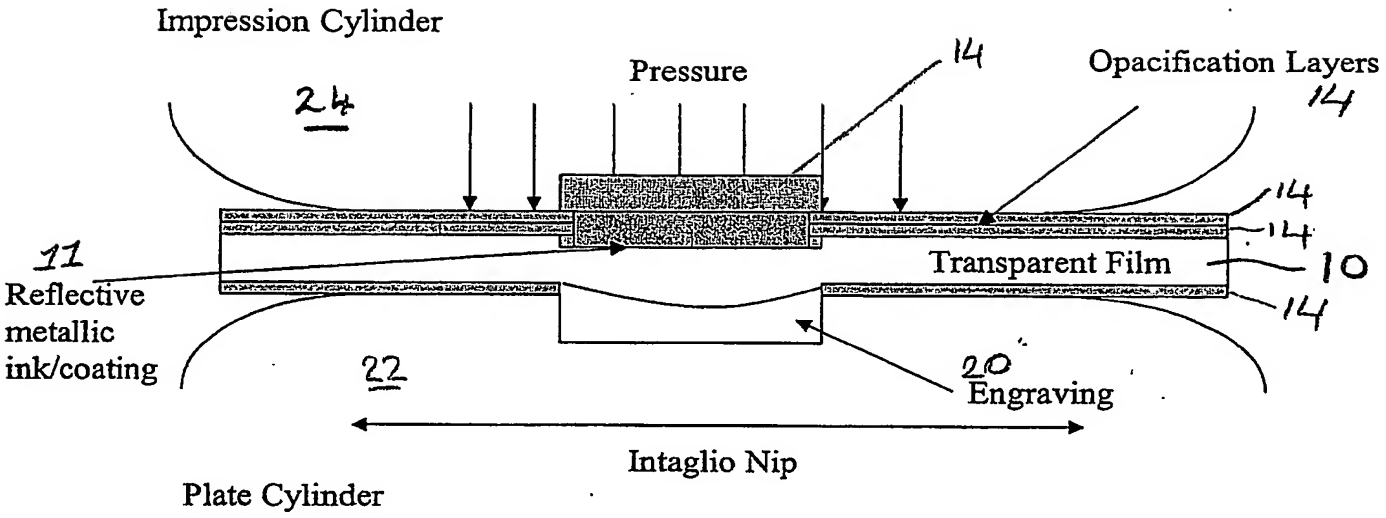
Impression Cylinder
24
Pressure
14
Opacification Layers
14
14
14
11
Reflective
metallic
ink/coating
Transparent Film
10
14
22
20
Engraving
Intaglio Nip
Plate Cylinder

FIG. 8

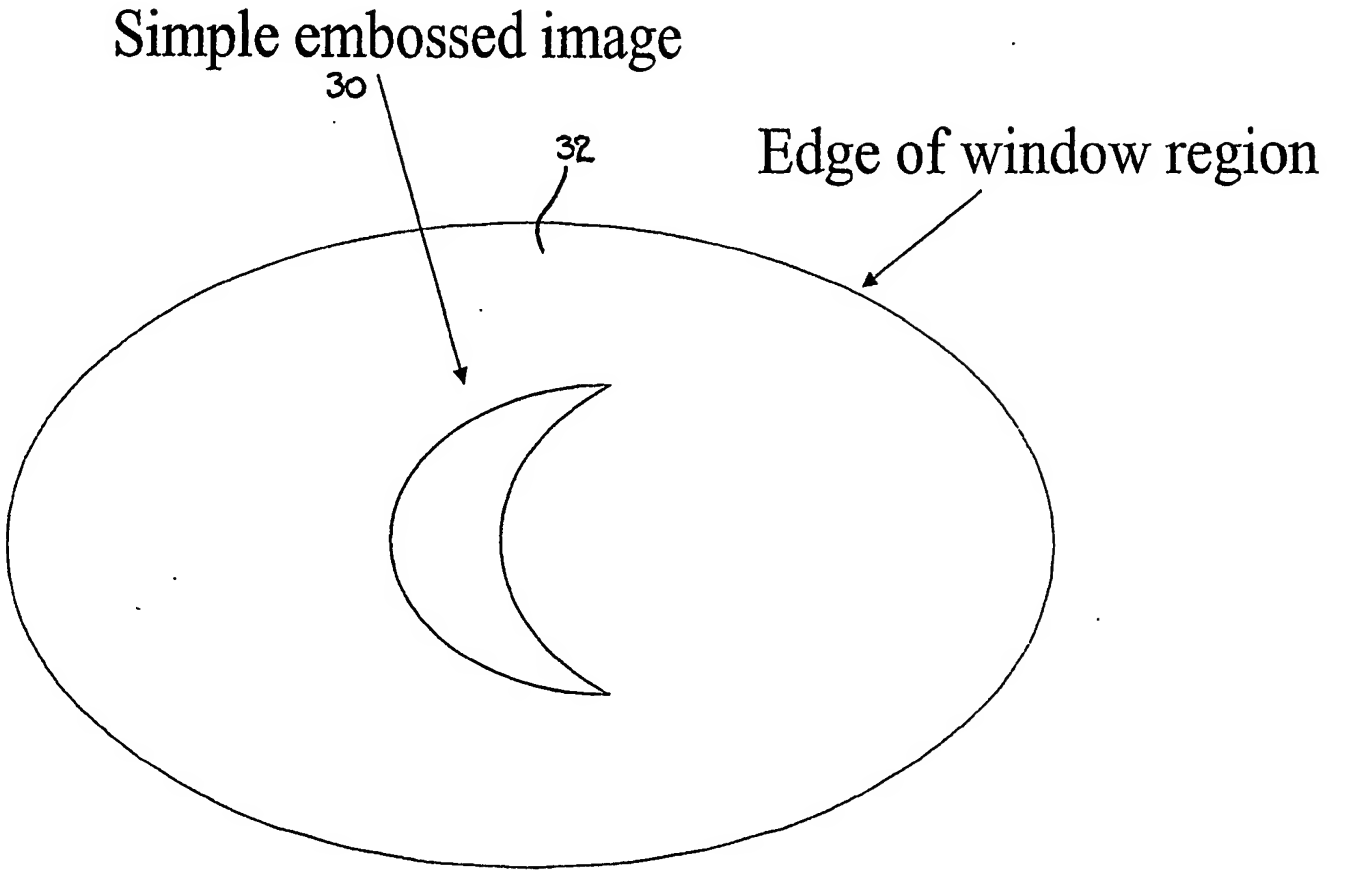

FIG. 9

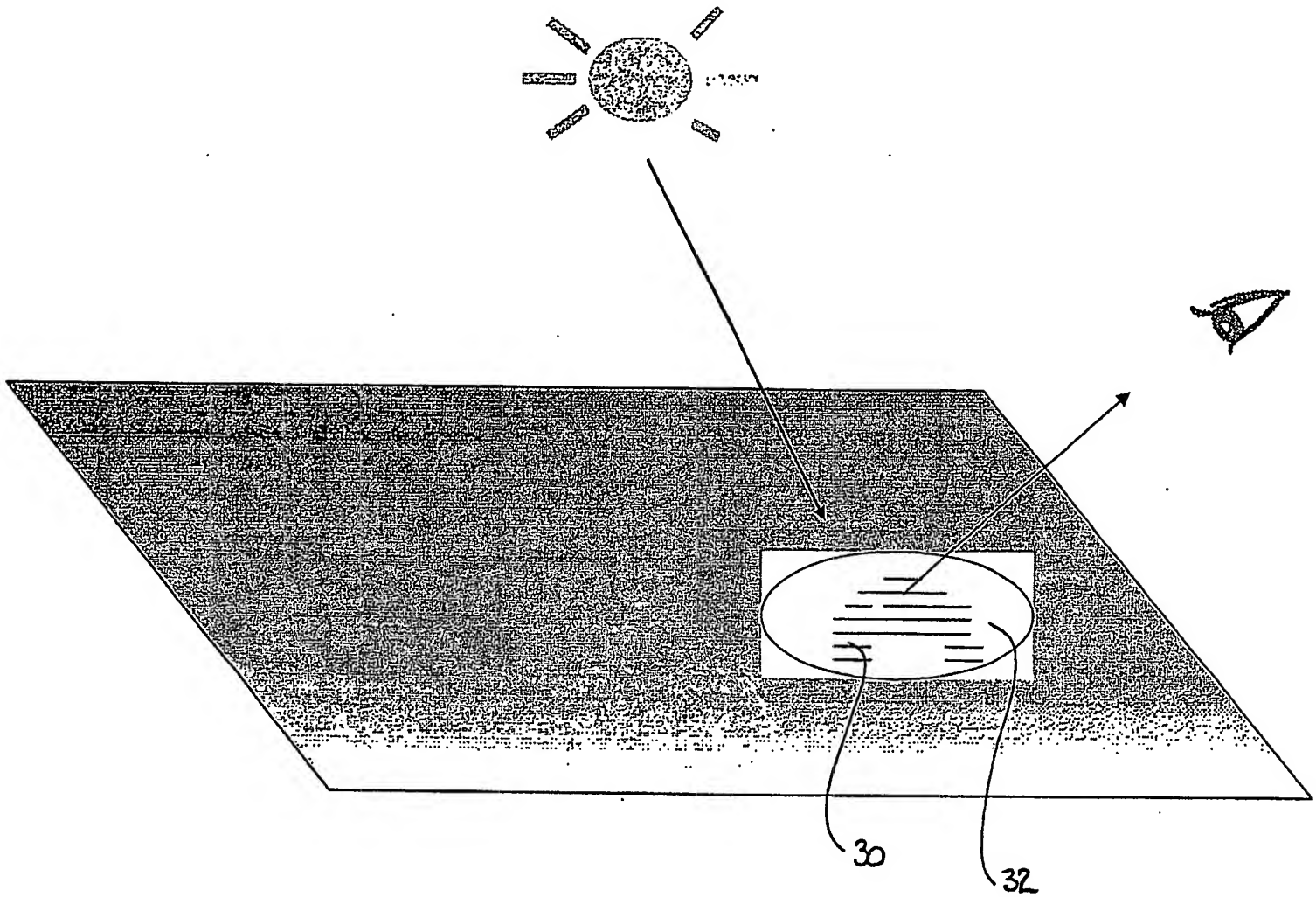

FIG. 10

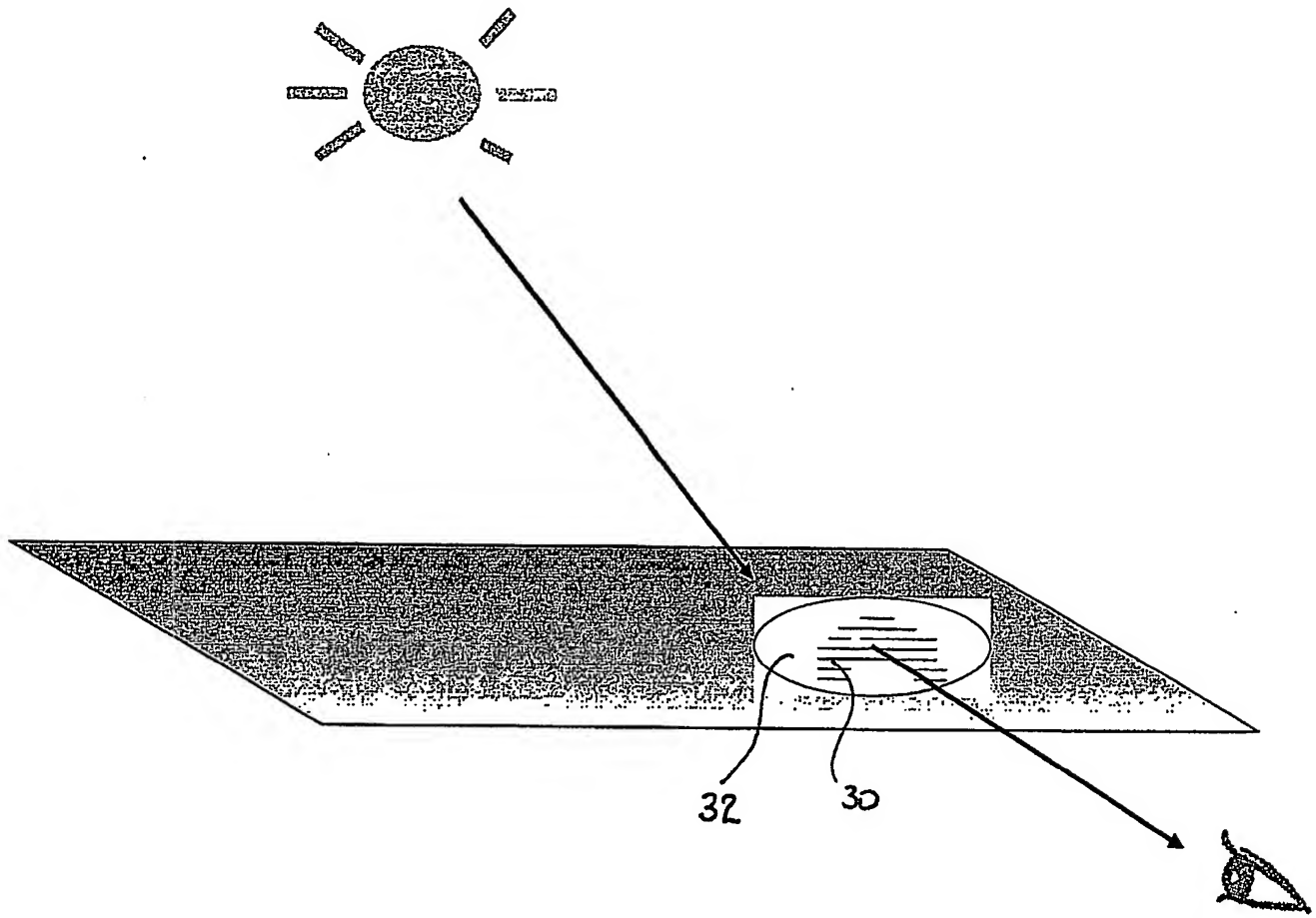

FIG. 11

Image substantially invisible oblique viewing angle

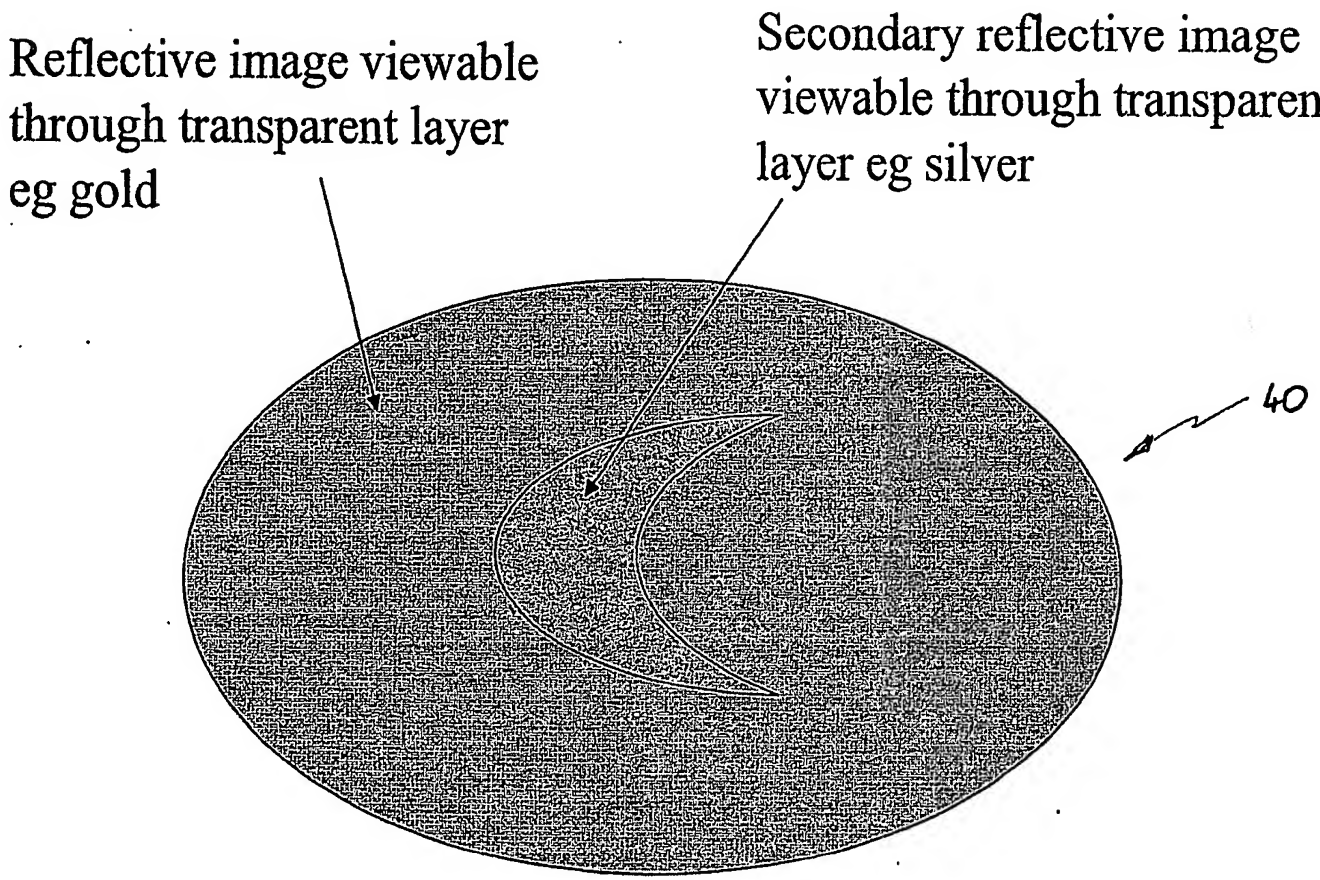
Reflective image viewable through transparent layer eg gold
Secondary reflective image viewable through transparent layer eg silver
40

FIG. 12

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